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PHASE I

SUPPLEMENTAL INVESTIGATION SUMMARY REPORT

ENVIRO-CHEM SUPERFUND SITE

ZIONSVILLE, INDIANA

PREPARED FOR:

ENVIRONMENTAL CONSERVATION AND CHEMICAL CORPORATION TRUSTS

PREPARED BY:

AWD TECHNOLOGIES, INC.

INDIANAPOLIS, INDIANA

AWD PROJECT NUMBER 2259.810

OCTOBER 1992

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FIGURES

TABLES

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1.0 INTRODUCTION

This document presents a data summary and evaluation of the (Phase I) Supplemental Investigation performed at the Enviro-Chem Site in Zionsville, Indiana. The Supplemental Investigation was conducted on behalf of the Enviro-Chem Trusts by AWD Technologies, Inc. (AWD) from September 16 through 18, 1992 to support the final remedial design.

The objectives of the Supplemental Investigation were to determine the present depth of the water table onsite and to define the implication of the water table depth on the design requirements for the proposed soil vapor extraction system (SVES). The Supplemental Investigation was necessary because a preliminary site visit by AWD on September 2, 1992 indicated that the water table had risen since the 1988 pilot scale study documented in the SVES report (ERM, July 1988), and is presently within a few feet of ground surface.

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2.0 SCOPE OF WORK

A draft work plan was submitted to U.S. EPA Region V on September 14, 1992 outlining the proposed scope of work. The Supplemental Investigation consisted of four tasks:

- Task 1 - Mobilization
- Task 2 - Water Level Measurement
- Task 3 - In-Situ Hydraulic Testing
- Task 4 - Data Reduction and Summary Report

Task 1 consisted primarily of a review of existing site data, work plan development, and preparation to complete field activities. Tasks 2 and 3 comprised the activities completed in the field. The development and presentation of this report is the product of Task 4.

Task 2 consisted of the measurement of water levels and depths of selected monitoring wells and piezometers on the Enviro-Chem Site and several wells and piezometers in close proximity to Enviro-Chem. All wells that were previously locked were relocked with new, keyed-alike locks. Copies of the new lock keys have been sent to U.S. EPA Region V and to Mr. James R. Smith at the Indiana Department of Environmental Management (IDEM).

The water level in each monitoring well was measured with a handheld electronic water level meter (m-scope). Where accessible, measurements were taken from the innermost well casing. In addition, depth measurements were taken from each well with reference to the same measuring point for water level measurements. The existing site survey data for these well locations were assumed to be accurate, therefore all measurements in this report have been referenced to the existing site survey data.

Task 3 consisted of the performance of in-situ hydraulic tests on selected monitoring wells and piezometers. This work was performed to address the well performance of selected existing wells. The well performance was identified as a critical issue for identifying any true rise in water table elevation since the 1988 SVES pilot scale program (ERM, July 1988). Rising head slug tests and purge tests were conducted to semi-quantitatively estimate whether the water level data collected from the target wells were useable.

The scope of work for the Phase I Supplemental Investigation did not include groundwater sampling for chemical analysis.

All purge water from the hydraulic testing, and decontamination fluids, were collected and staged onsite in a 55-gallon drum. A second waste storage drum was filled with solids (including waste personal protective equipment) and also left onsite on the southern concrete pad. Each drum was labeled with its contents and date of collection.

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3.0 DATA PRESENTATION

3.1 Condition of Existing Monitoring Wells/Piezometers

Table 1 of the Supplemental Investigation Work Plan (AWD, September 1992) provided a list of target monitoring wells and piezometers for water level measurement. Historical monitoring wells ECC-1A, ECC-3A, ECC-4A, and ECC-6A could not be found during the Supplemental Investigation. From discussions with personnel at the adjacent Boone County Recycling Center, it is likely that Wells ECC-1A and ECC-4A have been destroyed while Wells ECC-3A and ECC-6A may have been obstructed by very heavy brush. In addition to the existing monitoring wells, Northside Sanitary Landfill (NSL) test boring piezometers SBP-71, SBP-72, and SBP-75 could not be found. Piezometer SBP-60 was found to be flowing (artesian) but was partially covered by fill at the southwestern gate of the NSL site. Eight piezometers were discovered to exist on the southern concrete pad instead of nine, thus the designation "PZ-9" from Table 1 of the work plan has been deleted.

Figure 1 presents a site map with the approximate locations of the wells/piezometers that were measured during the Supplemental Investigation. Table 1 presents a listing of the measured wells/piezometers and their general appearance/above ground condition. The approximate locations were necessary because none of the existing site maps had previously located all of the wells and piezometers on the same map. In addition, it is believed that the locations of the unnamed ditch southeast of Enviro-Chem, and the NSL access road, have been moved since the last site work by U.S. EPA in 1988.

In general, the condition of the original Enviro-Chem site monitoring wells (ECC-1 through ECC-11) is fair to poor. As stated previously, Wells ECC-1A, ECC-3A, ECC-4A, and ECC-6A could not be found. Wells ECC-4C and ECC-7A are visibly damaged, and Well ECC-5A is at ground surface in a high traffic area. Only Wells ECC-8A, ECC-10A, and ECC-11A are in visibly good condition. Because of the identified well conditions, the hydraulic testing performed under Task 3 had to be altered in the field (as explained in Section 3.3).

3.2 Water Table Elevation

The preliminary site visit on September 2, 1992 indicated that the water table had risen above the "9 foot below ground surface level" as reported in the 1988 pilot scale SVES report (ERM, July 1988). In fact, water levels were visible in the piezometers on the concrete pad at depths less than 1 foot below ground surface. Task 2 was intended to confirm this apparent rise in the water table elevation.

The 1988 Technical Memorandum No. 2 (CH2M Hill, November 1988) reported that the "the fluvial/colluvial sand, and an englacial sand, make up the uppermost water bearing unit" at the site. This water bearing unit is the "sand and gravel" unit referred to in Exhibit A of the Consent Decree. Exhibit A also requires the monitoring of saturated conditions in the fine grained alluvial (or glacial) sediment above the sand and gravel unit. This saturated zone has been primarily monitored by a single well, ECC-MW-11A, and is referred to in Exhibit A as the "till" unit.

In addition to ECC-MW-11A, several additional piezometers have been screened in material above the top of the sand and gravel unit. These piezometers include the concrete pad piezometers (designated PZ-1 through PZ-8) and the pilot scale SVES standpipes. From the water level measurements taken from these piezometers, it is clear that, at present, the sediment is saturated within 1 to 2 feet of ground surface. Well ECC-MW-11A, which is screened 5 to 10 feet lower in elevation than these piezometers, exhibited a slightly lower water level that is still within 3.5 feet of ground surface.

Table 2 presents the reported screened elevations of the selected monitoring wells and piezometers, and the measured water levels from those wells (in both feet below ground surface and elevation above mean sea level). From these data, it is apparent that the water level elevations exhibited by the pad piezometers, SVES standpipes, and Well ECC-MW-11A are significantly higher than the water level elevations within the sand and gravel unit. Figure 2 presents the water levels recorded for the shallow piezometers and Figure 3 presents the water levels recorded for the wells screened across the sand and gravel unit.

The inferred groundwater contours from Figure 2 indicate that groundwater in the saturated fine grained material within the remedial boundary is flowing to the southeast (toward the existing sump at the southeast corner of the concrete pad). The inferred groundwater contours in the sand and gravel unit from Figure 3 indicate flow in a more southerly direction (toward the Third Site Pond and Finley Creek south of the Third Site Pond). Note that the flow direction in the sand and gravel unit was estimated using only those wells that are screened across the same elevations, and are in good physical condition (Table 1). Some wells, such as Well ECC-MW-7A and ECC-MW-10A, exhibited water levels that do not match this interpretation, however this interpretation is generally consistent with the RI/FS and Technical Memorandum No. 2 (CH2M Hill, 1988).

The saturation of the fine grained material above the sand and gravel unit may affect the design of the proposed SVES system. Even though June and July 1992 were "wetter" months than average, the site area apparently received near normal precipitation from mid-August through the present. In fact, the site received no rain within 1 week prior to the Supplemental Investigation. The June 1988 SVES Pilot Study (ERM, July 1988) was conducted during the lowest recorded precipitation period in Indiana since 1921 (USGS, 1992). According to the USGS, June 1988 was recorded as a severe drought period where 12 of 20 USGS monitoring wells across Indiana fell to record low water levels. After considering the time period in which the pilot scale SVES study was performed, and the Supplemental Investigation measurements, it is clear that water handling issues have to be an integral part of the proposed SVES design. Section 4.0 presents the preliminary evaluation regarding operation of the SVES within the conditions identified during the Supplemental Investigation.

The recorded groundwater levels from the Supplemental Investigation in both the fine grained sediment and the sand and gravel zone are presently within 9 feet of ground surface. The water levels in the fine grained sediment are within 1 to 2 feet of ground surface within the remedial boundary. The water levels exhibited by wells screened solely in the sand and gravel unit are generally within 6 to 7 feet of ground surface.

The sand and gravel unit varies in thickness, lithological make-up, and elevation across the site. In addition to the water levels exhibited by wells screened in the sand and gravel unit, its vertical location (i.e., depth to the unit from ground surface) may also have an effect on the design of the proposed SVES. Figure 4 presents the estimated elevations of the top of the sand and gravel unit. It apparently ranges from 875 feet MSL to 870 feet MSL in elevation or approximately 17 to 10 feet below ground surface within the remedial boundary. Table 3 presents the available data on the depth to, and thickness of the sand and gravel unit that is available from historical monitoring well and test boring logs. Figure 5 presents a cross section of the applicable well construction data from Table 3 and the available (generalized) lithology underneath the remedial action area. This figure shows the change in elevation of the top of the sand and gravel unit from north to south and the recently measured water levels. These water levels graphically present a vadose zone that is less than 2 feet in thickness.

Again, Section 4.0 presents the preliminary evaluation of operation of the SVES within the conditions identified during the Supplemental Investigation.

3.3 In-Situ Hydraulic Testing

In-situ hydraulic testing was completed as part of Task 3. The testing consisted of rising head slug tests in Wells MW-ECC-8A, MW-ECC-10A, MW-ECC-11A, MW-ECC-12, and Piezometer PZ-1. In addition, Well MW-ECC-11A and Piezometers, PZ-2, PZ-3, PZ-4, PZ-5, PZ-6, PZ-7, and PZ-8 were bailed dry or were attempted to be bailed dry.

Table 4 presents a summary of the hydraulic conductivity estimates derived from the slug tests and Appendix A presents the raw data and calculations.

The calculated hydraulic conductivities ranged from 4.4×10^{-10} cm/sec to 6.9×10^{-3} cm/sec. Monitoring Well MW-ECC-12A exhibited the highest conductivity (presumably) because a portion of its screen is in the gravel pack of the U.S. EPA sump. Well ECC-MW-8A had a relatively high permeability because it is reportedly screened in the more permeable sand and gravel below the finer grained saturated material. In contrast, the slug tests from ECC-MW-11A and PZ-1 indicate much lower permeability associated with the fine grained "till" unit.

Note that the calculated values are very approximate due to a lack of various well construction details and uncertainty regarding the wells being screened in confined or water table conditions.

The purge tests were conducted to semi-quantitatively determine if the selected wells were in operating condition or had become open to surface water (i.e., had become sumps). Because of the apparently high conductivity at Wells ECC-MW-8A, ECC-MW-10A, and ECC-MW-12A, and the consistency in their water levels, no purge tests were necessary on these wells. Instead, purge tests were conducted on ECC-MW-11A (after completion of the slug test) and Piezometers PZ-2 through PZ-8. Most of the piezometers were bailed dry but had recovered within 18 hours. Piezometers PZ-6 and PZ-8 were not able to be entirely evacuated by hand bailing. In fact, the piezometers were recharging quickly enough to stay within a few inches of their initial static levels.

Prior to purging, a small amount of a floating, dark, oily substance was discovered on top of the water in Piezometers PZ-7 and PZ-8. This substance was, at a maximum, 0.5 inches thick and did not immediately return to the water surface in each of the piezometers following the purge tests.

The purge tests indicate that Well ECC-MW-11A and the pad piezometers are presently usable to define shallow saturation of sediment beneath and adjacent to the concrete pad. Also, the shallow groundwater collected by the pad piezometers appears to be at least contiguous across the pad (which comprises more than 25 percent of the defined remedial action area). The water levels recorded in the SVES standpipes appear to be compatible with the water levels beneath the concrete pad further indicating that the water table has risen substantially since the pilot scale SVES study.

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4.0 RECOMMENDATION FOR FINAL DESIGN

The Supplemental Investigation data indicate that the water table (or shallowmost saturated sediment zone) has increased in elevation from that identified during the June 1988 SVES Pilot Study. As a result of the data, the SVES should include consideration of design elements for the dewatering of the shallow saturated sediments to the depth of the SVES trenches, maintenance of the dewatered condition to that depth level, and design requirements to separate phase flow in the event that the identified floating product is more extensive than what has been identified in this report. In addition to dewatering, other remedial alternatives may be appropriate.

4.1 Preliminary Dewatering Calculations

Preliminary dewatering calculations can be made to estimate the amount of shallow groundwater that needs to be removed in order to operate the proposed SVES. Appendix B presents these calculations.

The preliminary dewatering calculations have been made to estimate the amount of shallow groundwater that needs to be removed in order to operate the proposed SVES. An average hydraulic conductivity of 1.0×10^{-5} cm/sec and a porosity of 0.10 were used for the zone of dewatering based on the data presented in the RI Report for the fine-grained till unit. Saturated thickness was assumed to be from present depth to water level measured in the pad piezometers and SVES standpipes down to a depth of 9 feet, which is the presently proposed depth of the SVES trenches.

The preliminary calculations show an estimate of approximately 750,000 gallons of groundwater stored in the upper 9 feet of till within the entire remedial site boundary.

In addition to the removal of the initial volume of groundwater stored within the proposed operating depth of the SVES, dewatering will have to be continued to sustain dry conditions down to the operating depth. A very approximate calculation of this continuous dewatering flow rate is presented with the attached calculations. An estimate of approximately 1.5 gallons per minute has been derived from these calculations. Figure 6 presents the remedial action area and the assumed location of the dewatering trenches used for the calculations. This calculation does not include provisions for the decrease in recharge to the shallow till after placement of the proposed cap nor influence of the sand and gravel unit on the dewatering system. It also represents pumping under steady state conditions. Pumping rates will be higher at the onset of pumping until steady state conditions are reached.

Because of the limited data base on the hydraulic parameters of the till unit, and the potential influence of the underlying sand and gravel unit (especially in the southern portion of the site), the flow rates may be one order of magnitude greater than estimated. For this reason, additional site data should be obtained on the till unit as described in Section 4.2.

4.2 Additional Investigation

Assuming that the SVES performance specifications include provisions for dewatering the shallow fine grained sediments to the proposed depth of the SVES trenches, a system for collecting and treating this groundwater should also be included in the performance specifications. Such a system design should also include a provision for phase separation in the event significant volumes of light nonaqueous phase liquids are recovered by the dewatering system.

Prior to completion of the final SVES design specifications, a second phase of the Supplemental Investigation is recommended to be able to better estimate the eventual steady-state groundwater flow out of the necessary dewatering system. This study will involve the excavation, geologic logging, and testing-scale pumping out of two long trenches (no less than 50 feet in length). Each trench will be excavated to a depth of 9 feet. Observation piezometers will be installed on either side of the trenches to monitor the reaction of the water table during pumping. In the event that other options are considered, additional investigative work to be performed at the same time may also be appropriate. A formal work plan regarding this additional investigative work will be submitted and available for U.S. EPA review by October 28, 1992.

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5.0 REFERENCES

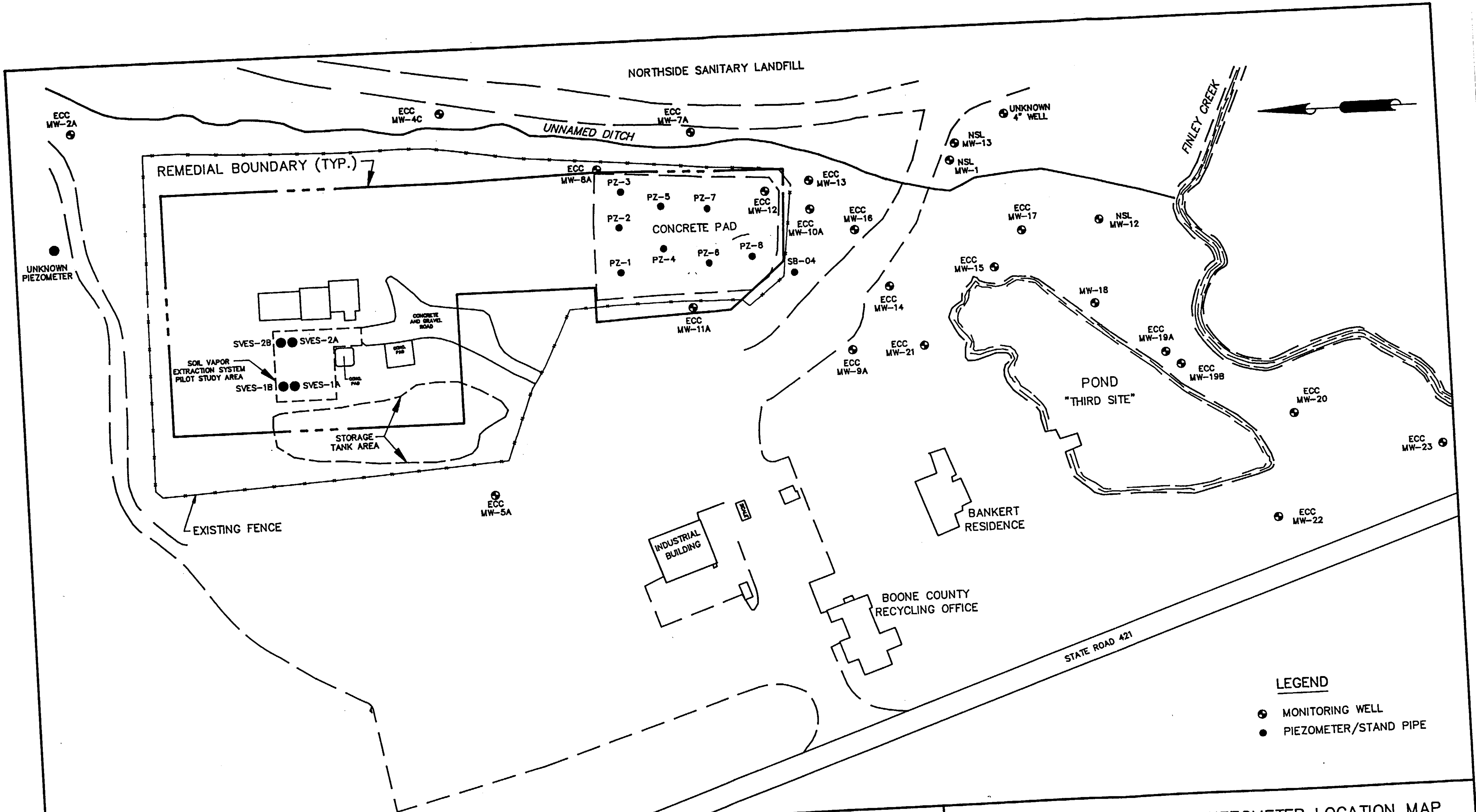
1. 1988, (July 8), Interim Report of Vapor Extraction Pilot Test; Environmental Resources Management - North Central, Inc. in Attachment No. 1 of Exhibit A of Site Consent Decree, 7 pp.

2. 1988, (November 9), Technical Memorandum No. 2 Geotechnical, Hydrogeological and Supplemental Predesign Investigation - North Side Sanitary Landfill/Environmental Conservation and Chemical Corporation, Zionsville, Indiana, CH2M Hill Inc., 25 pp.

3. 1992, (September 14), Draft Supplemental Investigation Work Plan in Cover Letter to Ms. Karen A. Vendl, U.S. EPA Region V from Bradford K. Grow, AWD Technologies, Inc.

4. 1992, Description and Effects of 1988 Drought on Ground-Water Levels, Streamflow, and Reservoir Levels in Indiana; U.S. Geological Survey, Water Resources Investigations Report 91-4100, 91 pp.

FIGURES



AWD TECHNOLOGIES, INC.

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MONITORING WELL AND PIEZOMETER LOCATION MAP

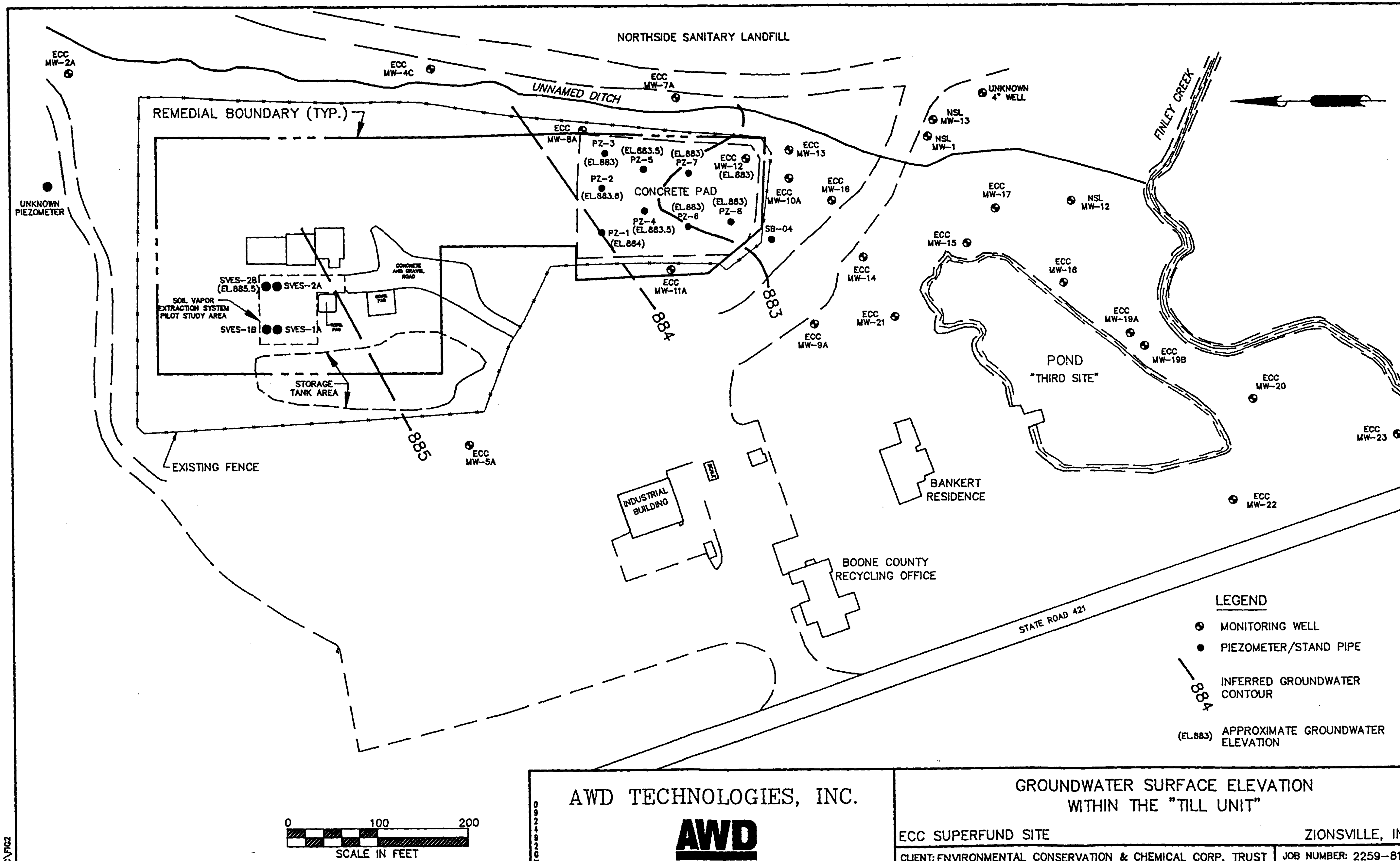
ECC SUPERFUND SITE

ZIONSVILLE, IN

CLIENT: ENVIRONMENTAL CONSERVATION & CHEMICAL CORP. TRUST		JOB NUMBER: 2259-810
SCALE: AS SHOWN	FIGURE NUMBER 1	REV 0

092492GW

FILE: \ECC\FIG1



AWD TECHNOLOGIES, INC.

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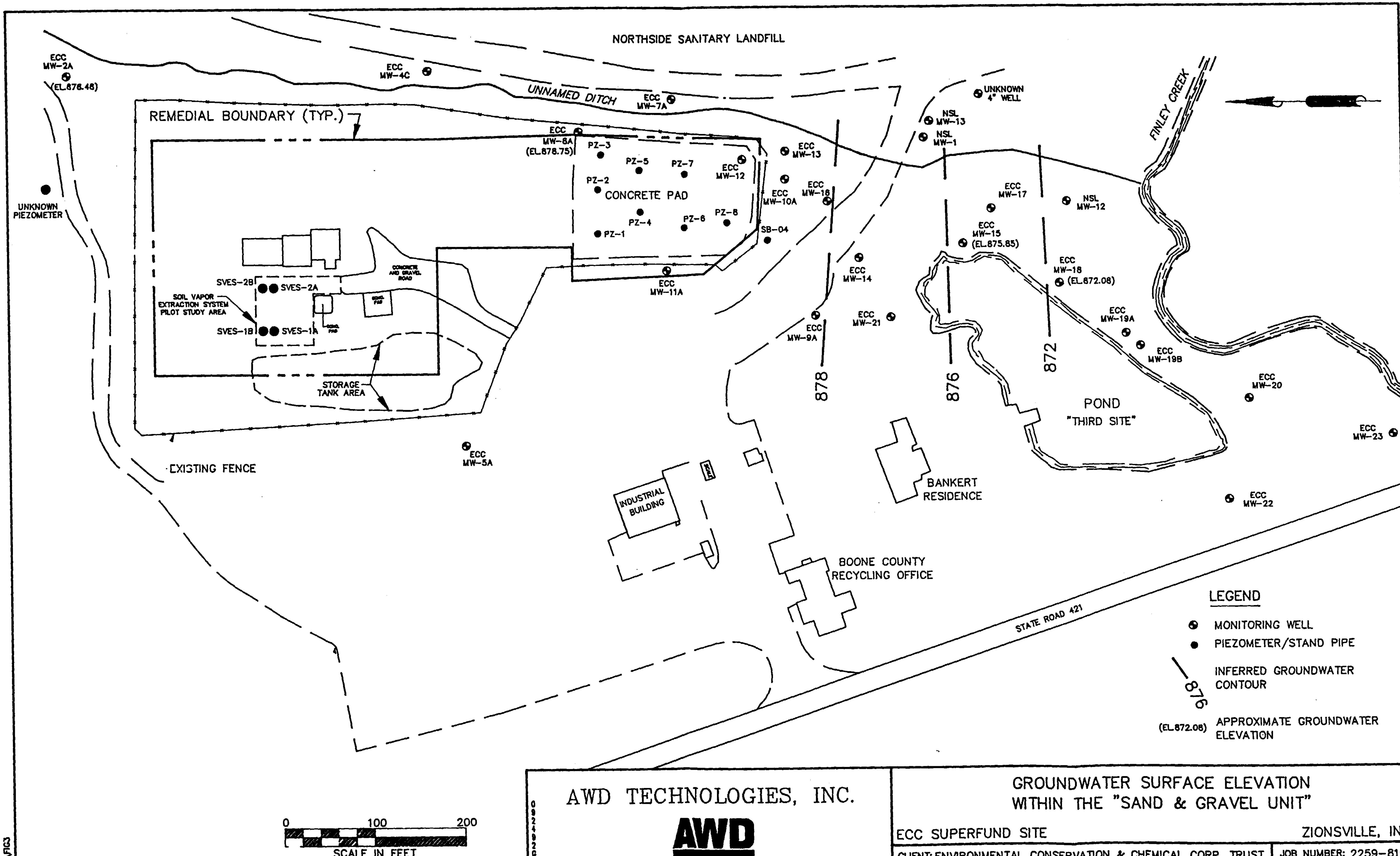
GROUNDWATER SURFACE ELEVATION WITHIN THE "TILL UNIT"

ECC SUPERFUND SITE — ZIONSVILLE, IN

CLIENT: ENVIRONMENTAL CONSERVATION & CHEMICAL CORP. TRUST — JOB NUMBER: 2259-810

SCALE: AS SHOWN — FIGURE NUMBER 2 — REV 0

FILE: \ECC\FIG2



AWD TECHNOLOGIES, INC.

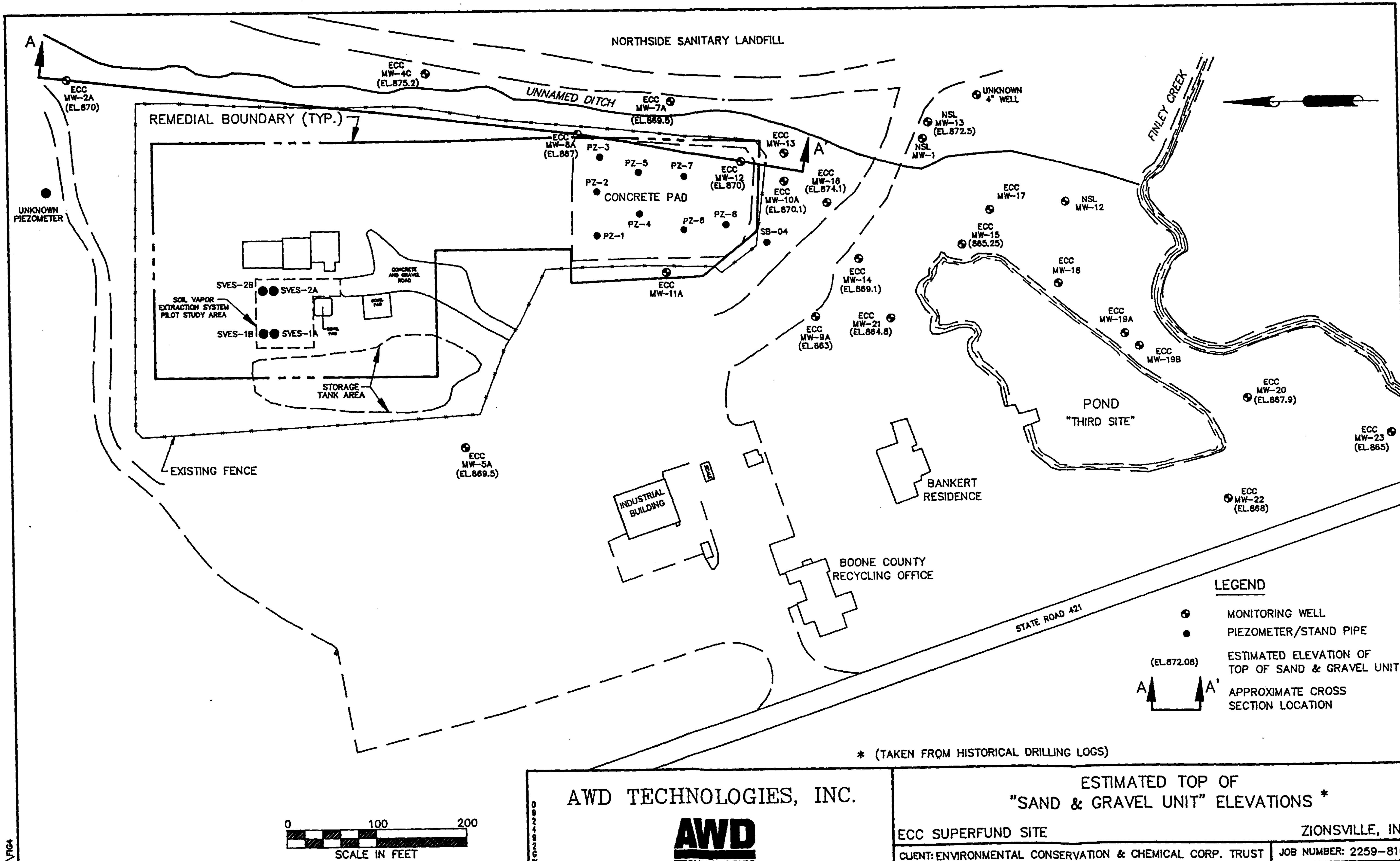
AWD TECHNOLOGIES

GROUNDWATER SURFACE ELEVATION WITHIN THE "SAND & GRAVEL UNIT"

ECC SUPERFUND SITE	ZIONSVILLE, IN
CLIENT: ENVIRONMENTAL CONSERVATION & CHEMICAL CORP. TRUST	JOB NUMBER: 2259-810
SCALE: AS SHOWN	FIGURE NUMBER 3 — REV

092492CW

LE:\ECC\FIG3

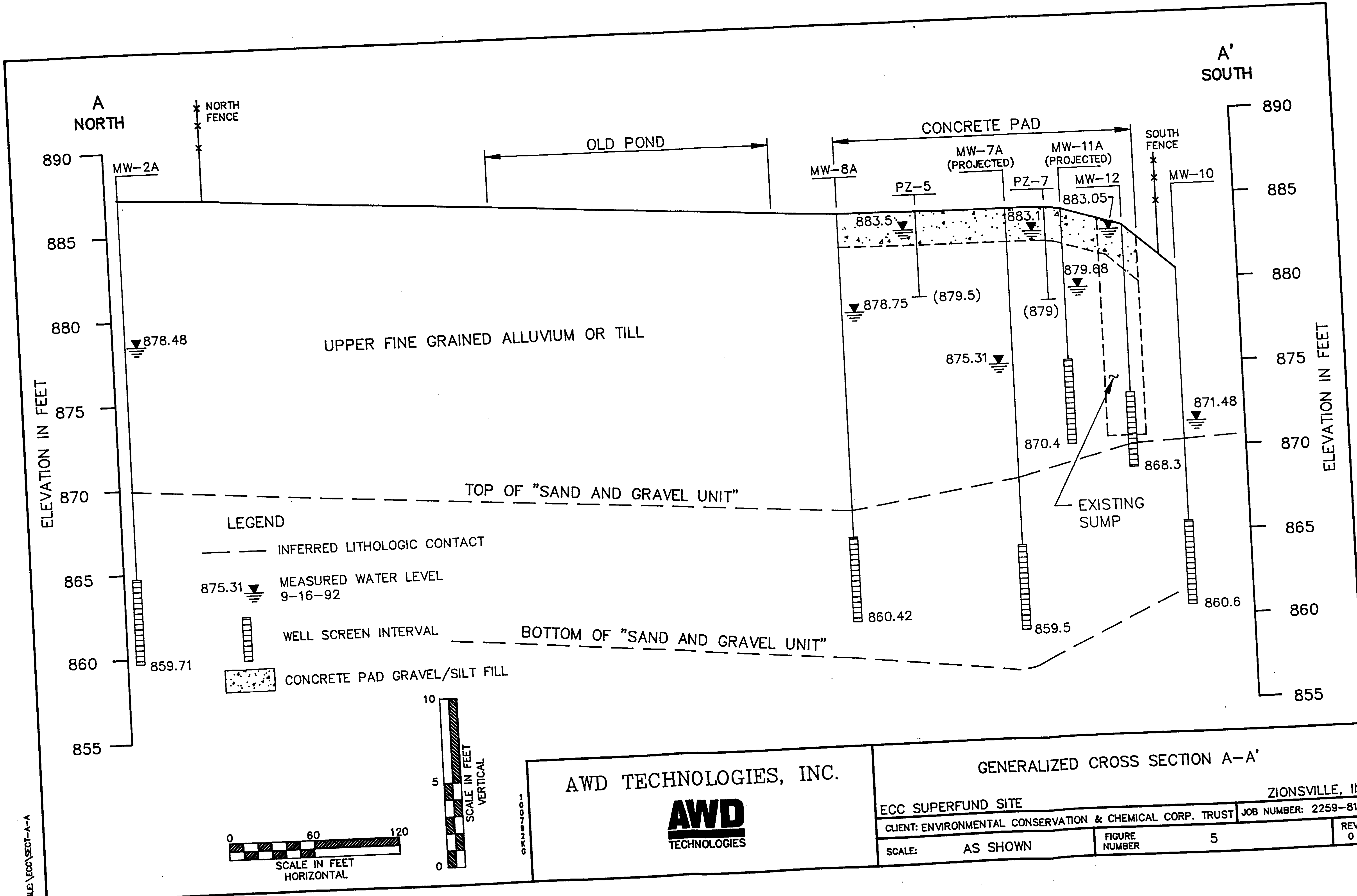


* (TAKEN FROM HISTORICAL DRILLING LOGS)

AWD TECHNOLOGIES, INC.	ESTIMATED TOP OF "SAND & GRAVEL UNIT" ELEVATIONS *
AWD TECHNOLOGIES	ECC SUPERFUND SITE — ZIONSVILLE, IN
	CLIENT: ENVIRONMENTAL CONSERVATION & CHEMICAL CORP. TRUST — JOB NUMBER: 2259-810
	SCALE: AS SHOWN — FIGURE NUMBER 4 — REV 0

0924826W

FILE:\ECC\FIG4



AWD TECHNOLOGIES, INC.

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GENERALIZED CROSS SECTION A-A'

ECC SUPERFUND SITE

ZIONSVILLE, IN

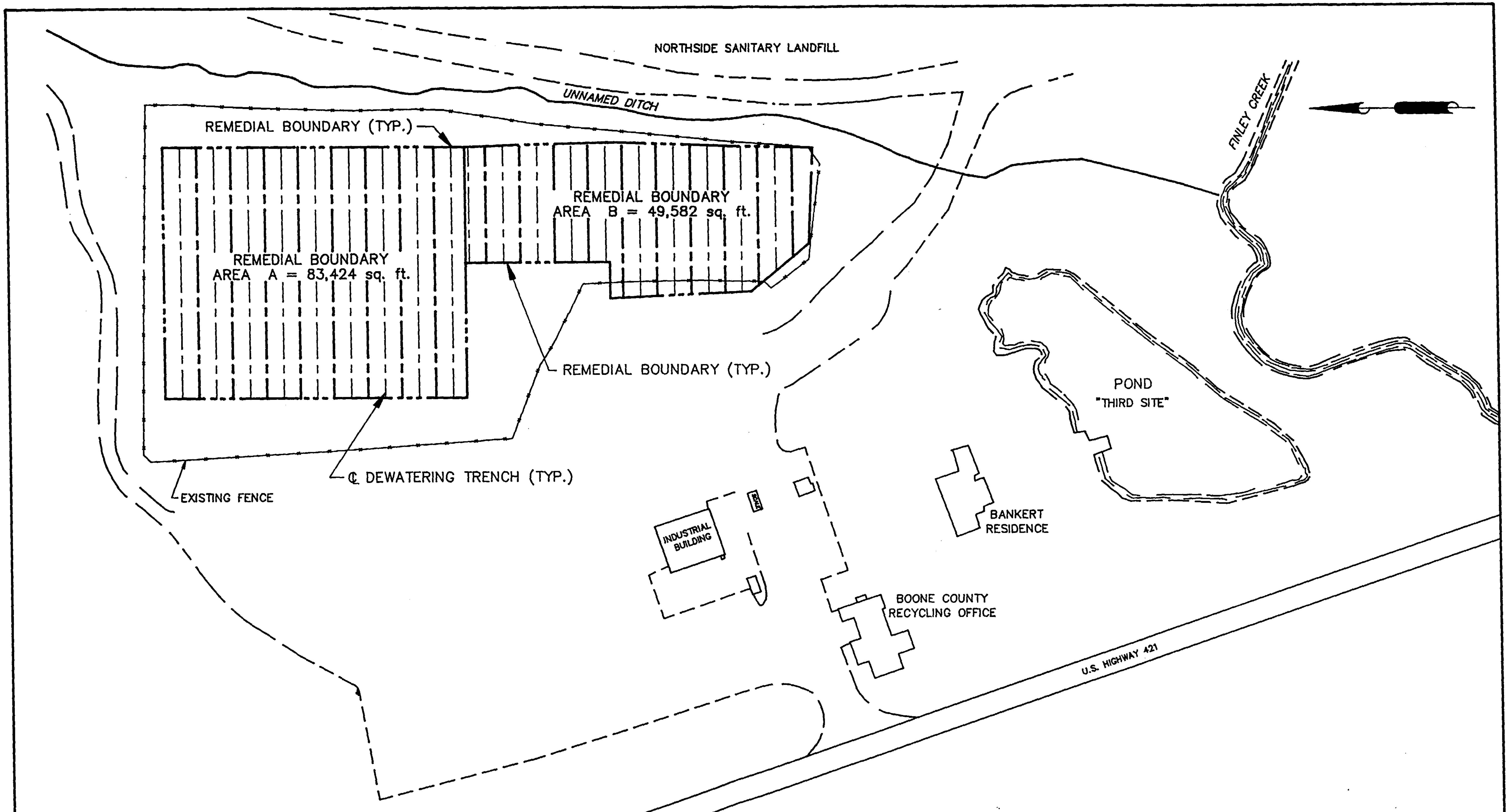
CLIENT: ENVIRONMENTAL CONSERVATION & CHEMICAL CORP. TRUST

JOB NUMBER: 2259-810

SCALE: AS SHOWN

FIGURE NUMBER 5

REV 0



AWD TECHNOLOGIES, INC.

AWD TECHNOLOGIES

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REMEDIAL ACTION AREA FOR
PRELIMINARY DEWATERING CALCULATIONS

ECC SUPERFUND SITE ZIONSVILLE, IN

CLIENT: ENVIRONMENTAL CONSERVATION & CHEMICAL CORP. TRUST | JOB NUMBER: 2259-810

SCALE: AS SHOWN | FIGURE NUMBER 6 | REV 0

FILE: \ECC\FIG6

TABLE 1

MEASURED MONITORING WELLS AND PIEZOMETERS
SUPPLEMENTAL INVESTIGATION
ENVIRO-CHEM SITE FINAL DESIGN
SEPTEMBER 1992

Well Number	Visible Well Condition
ECC-2A	Inner casing near ground surface Outer steel casing okay[1]
ECC-4C	Casing cracked; well flowing
ECC-5A	Outer casing at ground surface No visible concrete around casing Had barrel around it to protect from truck traffic
ECC-7A	Outer casing missing Inner casing cracked at top No visible concrete around inner casing
ECC-8A	Inner casing near ground surface Outer casing okay
ECC-9A	Okay[1]
ECC-10A	Okay[1]
ECC-11A	Okay[1]; heavy brush/small trees around well
ECC-12	Okay[1]
ECC-13	Okay[1]
ECC-14	Okay[1]
ECC-15	Okay[1]
ECC-16	Okay[1]
ECC-17	Okay[1]
ECC-18	No concrete visible around outer well casing; otherwise okay[1]
ECC-19A	No concrete visible around outer well casing; otherwise okay[1]
ECC-19B	No concrete visible around outer well casing; otherwise okay[1]
ECC-20	Okay[1]
ECC-21	Concrete seal cracked at ground surface

TABLE 1

MEASURED MONITORING WELLS AND PIEZOMETERS
SUPPLEMENTAL INVESTIGATION
ENVIRO-CHEM SITE FINAL DESIGN
SEPTEMBER 1992

Well Number	Visible Well Condition
ECC-22	Well located in drainage swale adjacent to Route 421; hinge bent
ECC-23	Okay(1)
NSL MW-12	No concrete visible around outer well casing; otherwise okay(1)
NSL MW-13	Outer casing near ground surface, partially buried by sediment
NSL MW-1	No visible concrete around outer casing; otherwise okay
NSL-SBP-70	Single PVC casing with flush cap No visible concrete around riser pipe
NSL-SBP-80	Partially buried by sediment Casing cracked Piezometer flowing
PZ-1	Single PVC casing with flush cap
PZ-2	Single PVC casing with flush cap
PZ-3	Single PVC casing with flush cap
PZ-4	Single PVC casing with flush cap
PZ-5	Single PVC casing with flush cap
PZ-6	Top of PVC casing cracked; no cap
PZ-7	Single PVC casing with flush cap
PZ-8	Single PVC casing with flush cap
SB-04	Single PVC casing; bent 30° from vertical
North Perimeter Piezometer	Single PVC casing with flush cap
SVES-1A	Single 4-inch PVC pipe with flush cap
SVES-1B	Single 4-inch PVC pipe with flush cap
SVES-2A	Single 4-inch PVC pipe with flush cap

TABLE 1

MEASURED MONITORING WELLS AND PIEZOMETERS
SUPPLEMENTAL INVESTIGATION
ENVIRO-CHEM SITE FINAL DESIGN
SEPTEMBER 1992

Well Number	Visible Well Condition
SVES-2B	Single 4-inch PVC pipe with flush cap
Unknown 4-Inch Monitoring Well	4-inch PVC inner casing; outer steel casing; okay condition[1]

Notes

(1) Okay = Inner and outer casing in visibly good condition.

TABLE 2

WELL CONSTRUCTION SUMMARY TABLE*
ENVIRO-CHEM SITE
ZIONSVILLE, INDIANA
PAGE 1 OF 3

Well Number	Screen Depth	Screen Elevation	Ground Surface Elevation *****	TOC Elevation *****	Water Level TOC	Stick Up (ft above ground)	Water Level (ft BGS)	Water Level Elevation	Hydro Unit
ECC-2A**	- 27.5	- 859.71	887.21▲▲	888.5	10.02	3.03	6.99	878.48	Sand and gravel
ECC-5A	18.7 - 23.7	868.55 - 863.55	887.25▲▲	889.85▲▲	10.25	0.60	9.65	881.23	Sand and gravel
ECC-7A	- 22	- 859.53	881.53▲▲	883.93▲▲	8.62	3.00	5.62	875.31	
ECC-8A**	- 25	- 860.42	885.42▲▲	884.5	5.75	0.00	5.75	878.75	Sand and gravel
ECC-9A**	- 25	- 856.01	881.01▲▲	883.11	4.34	1.80	2.54	878.77	Sand and gravel
ECC-10A**	- 20	- 859.60	879.60▲▲	880.6	9.12	2.0	7.12	871.48	Glacial till and sand
ECC-11A**	- 14	- 870.40	884.40▲▲	885.2	5.52	2.10	3.42	879.68	Glacial till
ECC-MW12	10 - 15	873.3 - 868.3	883.3	885.5	2.45	2.10	0.35	883.05	Silt
ECC-MW13	4 - 14	876.2 - 866.2	880.2	883.3	10.31	3.0	7.31	872.99	Silty sand
ECC-MW14**	15 - 25	863.7 - 853.7	878.7	880.9	5.36	2.10	3.26	875.54	Sand and gravel
ECC-MW15	14 - 19	864.8 - 859.8	878.8	880.3	4.45	1.52	2.93	875.85	Sand and silt
ECC-MW16	9 - 14	869.6 - 864.6	878.6	881.0	8.14	2.12	6.02	872.86	Sand and gravel
ECC-MW17	11 - 16	869.8 - 864.8	880.8	883.0	8.17	2.20	5.97	874.83	Sand and gravel
ECC-MW18	15 - 20	862.2 - 857.2	877.2	879.9	7.82	2.14	5.68	872.08	Sand and gravel
ECC-MW19A	6.6 - 10.1	871.1 - 867.6	877.7	879.9	9.07	1.90	7.17	870.83	Sand and gravel and silty clay
ECC-MW19B	19.2 - 29.2	858.4 - 848.8	877.6	880.3	9.22	2.30	6.92	871.08	

TABLE 2

WELL CONSTRUCTION SUMMARY TABLE*
ENVIRO-CHEM SITE
ZIONSVILLE, INDIANA
PAGE 2 OF 3

Well Number	Screen Depth	Screen Elevation	Ground Surface Elevation *****	TOC Elevation *****	Water Level TOC	Stick Up (ft above ground)	Water Level (ft BGS)	Water Level Elevation	Hydro Unit
ECC-MW20	13 - 28	861.1 - 846.1	874.1	876.5	7.98	2.10	5.88	868.52	Sand and gravel
ECC-MW21	17 - 32	862.8 - 847.8	879.8	882.6	6.56	2.50	4.06	876.04	Sand and gravel
ECC-MW22**	20 - 30	853.4 - 843.4	873.4	875.7	7.32	1.90	5.42	868.38	Sand and gravel
ECC-MW23	Surface elevation not available				8.06	2.25	5.81	NM	
NSL MW-12**	3 - 23	870.59 - 850.59	873.59	874.1	4.61	2.15	2.46	869.49	Sand and gravel
NSL MW-13**	3.5 - 13.5	872.55 - 862.55	876.05	876.7	6.32	0.00	6.32	870.38	Silty sand and silty clay
NSL SBP-70	(29.99)***	Unknown		Unknown	11.14	1.80	9.34	NM	
NSL SBP-60	NM	Unknown		Unknown	Flowing		Above GS	NM	
SB-04	(34.26)***	Unknown		Unknown	4.03	2.50	1.53	NM	
SB-7 North Perimeter	(33.29)***	Unknown		Unknown	14.22	2.1	12.12	NM	

TABLE 2

WELL CONSTRUCTION SUMMARY TABLE*
ENVIRO-CHEM SITE
ZIONSVILLE, INDIANA
PAGE 3 OF 3

Well Number	Screen Depth***	Approximate Ground Surface Elevation****	TOC Elevation	Water Level TOC	Stick Up (ft above ground)	Water Level (ft BGS)	Approximate Water Level Elevation	Hydro Unit
PZ-1	(4.66)	885	Unknown	1.40	0.40	1.00	884	
PZ-2	(4.70)	885	Unknown	1.79	0.40	1.39	883.6	
PZ-3	(4.65)	884.5	Unknown	2.15	0.60	1.55	883	
PZ-4	(4.70)	884.5	Unknown	1.35	0.30	1.05	883.5	
PZ-5	(4.71)	884.5	Unknown	1.77	0.80	0.97	883.5	
PZ-6	(3.95)	884	Unknown	1.04	0.00	1.04	883	
PZ-7	(4.75)	883.7	Unknown	0.97	0.30	0.67	883	
PZ-8	(4.75)	883.7	Unknown	0.91	0.30	0.61	883	
SVES-1A	(8.30)	887.9	Unknown	8.21	6.0	2.21	885.7	
SVES-1B	(10.20)	887.9	Unknown	6.06	3.75	2.31	885.6	
SVES-2A	(10.20)	887.9	Unknown	6.95	5.70	1.25	886.7	
SVES-2B	(10.10)	887.9	Unknown	5.82	4.50	1.32	886.6	

Notes

* Compiled from Site RI/FS and Technical Memorandum No. 2.
** Elevation estimated using nearby soil boring elevation.
*** (#) = total depth of piezometer and not screen depth.
**** Ground surface elevation approximated from site topographic contour map.
***** Ground surface or top of casing elevation from Figure 6 Technical Memorandum No. 2 except where noted.
▲▲ Ground surface or top of casing elevation from Table 4-10 of RI.

TABLE 3

ELEVATION TO TOP OF THE SAND ZONE BASED ON DATA FROM TECHNICAL MEMORANDUM NO. 2
ENVIRO-CHEM CLASSIC SITE
ZIONSVILLE, INDIANA

Well or Boring	Cross Reference to Monitoring Well	Ground Surface Elevation (ft-msl)	Approximate Scaled Depth to Top of Sand Zone (ft)	Thickness of Sand and Gravel	Source of Information (Checked From Logs)	Approximate Top Elevation of Sand
ECC-MW-2A	---	886.94	16.0	?	Geologic Log	870.94
ECC-MW-3A		876.60	6	11.5	Geologic Log	870.6
ECC-MW-4C		884.62	9.5	8	Geologic Log	875.12
ECC-MW-5A		887.25	18	?	Cross Section E-E'	869.5
ECC-MW-6A		884(?)	13.5	11	Cross Section G-G'	870.5
ECC-MW-7A		881.53?	12.0	11.5	Geologic Log	869.53
ECC-MW-8A		884.5	(?) 17.5	?	Cross Section G-G'	867
ECC-MW-9A		881.01	18.0	>7.0	Geologic Log	863.1
ECC-10A		880.6	10.5	6	Cross Section A-A'	870.1
ECC-MW-11A*		884.40			Geologic Log	
SB-01	ECC-MW-12	883	13	8	Cross Section G-G'	870
SB-02	---	880.2	4.5	10	Cross Section A-A'	875.7
SB-03	---	879.8	20	3	Cross Section A-A'	859.8
SB-04	---	879.5	14	21	Cross Section A-A'	865.5
SB-05	---	883.9	18	24	Cross Section A-A'	865.9

TABLE 3

ELEVATION TO TOP OF THE SAND ZONE BASED ON DATA FROM TECHNICAL MEMORANDUM NO. 2
ENVIRO-CHEM CLASSIC SITE
ZIONSVILLE, INDIANA

Well or Boring	Cross Reference to Monitoring Well	Ground Surface Elevation (ft-msl)	Approximate Scaled Depth to Top of Sand Zone (ft)	Thickness of Sand and Gravel	Source of Information (Checked From Logs)	Approximate Top Elevation of Sand
SB-06	—	881.3	15	21	Cross Section B-B'	866.3
SB-07	—	878.7	11.5	13	Cross Section B-B'	867.2
SB-08	(MW-14?)	879.1	10	8	Cross Section B-B'	869.1
SB-09	(MW-16?)	878.6	4.5	8	Cross Section B-B'	874.1
SB-10		875.6	3.5	20	Cross Section C-C'	872.1
SB-11	—	878.4	12.5	5	Cross Section C-C'	865.9
SB-12	(MW-15?)	878.0	12.75	10	Cross Section C-C'	865.25
SB-13	(MW-21?)	879.8	16	21	Cross Section C-C'	864.8
SB-14	—	878.5	14.25	12?	Cross Section G-G'	864.25
SB-15	(MW-19?)	?	14.5	13	Geologic Log	?
SB-16	—	874.3	8?	15?	Cross Section D-D'	866.3
SB-17	—	875.8	5	23	Cross Section D-D'	870.8
SB-18	—	878.7	12	15	Cross Section D-D'	866.7
SB-19	—	878.9	22.5	12	Cross Section D-D'	856.4
SB-20	(MW-20)	873.9	6	20	Cross Section E-E'	867.9

TABLE 3

ELEVATION TO TOP OF THE SAND ZONE BASED ON
DATA FROM TECHNICAL MEMORANDUM NO. 2
ENVIRO-CHEM CLASSIC SITE
ZIONSVILLE, INDIANA

Well or Boring	Cross Reference to Monitoring Well	Ground Surface Elevation (ft-msl)	Approximate Scaled Depth to Top of Sand Zone (ft)	Thickness of Sand and Gravel	Source of Information (Checked From Logs)	Approximate Top Elevation of Sand
SB-21	(MW-22?)	873	5.0	26	Cross Section D-D'	868
SB-22	---	872.6	---	0	Cross Section G-G'	Not Present
SB-23	(MW-23)	875	10	16	Cross Section E-E'	865
NSL-MW-12		873.59	2	12.5	Geologic Log	871.6
NSL-MW-13		876.05	3.5	7	Cross Section C-C'	872.5
NSL-SBP-60		881	8.5	6	Cross Section B-B'	872.5
NSL-SBP-70		?	12.0 (?)	16 (?)	Geologic Log	?
NSL-SBP-71		886	11.0	16	Cross Section B-B'	875
NSL-SBP-75		880	8.0	9.5	Cross Section A-A'	872

Notes

* Not extended deep enough to penetrate sand and gravel unit.

TABLE 4

HYDRAULIC CONDUCTIVITY ESTIMATES FOR SLUG TESTS CONDUCTED ON SEPTEMBER 17, 1992 ENVIRO-CHEM SITE ZIONSVILLE, INDIANA

Piezometer/ Well Number	Calculated Hydraulic Conductivity	Apparent Zone Tested	Remarks
PZ-1	Not calculated, see remarks	Shallow till unit	Very low yield - shallow piezometer, not believed to be representative.
ECC-MW-8A	5.6×10^{-3} cm/sec	Shallow sand and gravel unit	Estimated value since well construction details not fully known.
ECC-MW-10A	3.1×10^{-4} cm/sec	Shallow sand and gravel unit	Estimated value since well construction details not fully known.
ECC-MW-11A	4.4×10^{-10} cm/sec	Shallow till unit	Very approximate value based on interpretation. Well screened in clayey material, some well construction details unknown. Very low value is unlikely.
ECC-MW-12	6.9×10^{-3} cm/sec	U.S. EPA gravel pack/shallow sand	Well is situated within the sump. Conductivity value may be too high.

DRAFT

APPENDIX A

IN-SITU HYDRAULIC TEST CALCULATIONS

AWD TECHNOLOGIES

CALCULATION WORKSHEET

CLIENT: ECC SITE	FILE NO.: 2259-810	BY: S. McDOUGALL	PAGE 1 OF 2
SUBJECT: MW 8A SLUG TEST		CHECKED BY: DAR 10/8/92	DATE: 9/23/92

MW8A

$2r_c = 2'' = 0.17'$ $r_c = 0.17/2 = 0.085'$

$2r_w = 8'' = 0.67'$ $r_w = 0.67/2 = 0.335'$ *

$H \approx$ [25' (Depth to Till?) - 5.75' (SWL BGL)] = 19.25 *

ASSUMES UNCONFINED CONDITIONS (TBD)

$L_w = 19.25'$ (?) *

$L_e = 8'$ (5' (?) Screen + 3' (?) SAND PACK) *

$L_e/r_w = 8'/0.335' = 23.88$

$C = 2.2$

(* ASSUMED DUE TO LACK OF SPECIFIC DATA)

ASSUMING $H = L_w$, BOWER & RICE METHOD IS:

$$\ln R_e/r_w = \frac{1}{\frac{1.1}{\ln(L_w/r_w)} + \frac{C}{(L_e/r_w)}} = \frac{1}{\frac{1.1}{\ln(19.25/0.335)} + \frac{2.2}{23.88}}$$

$$= 2.75$$

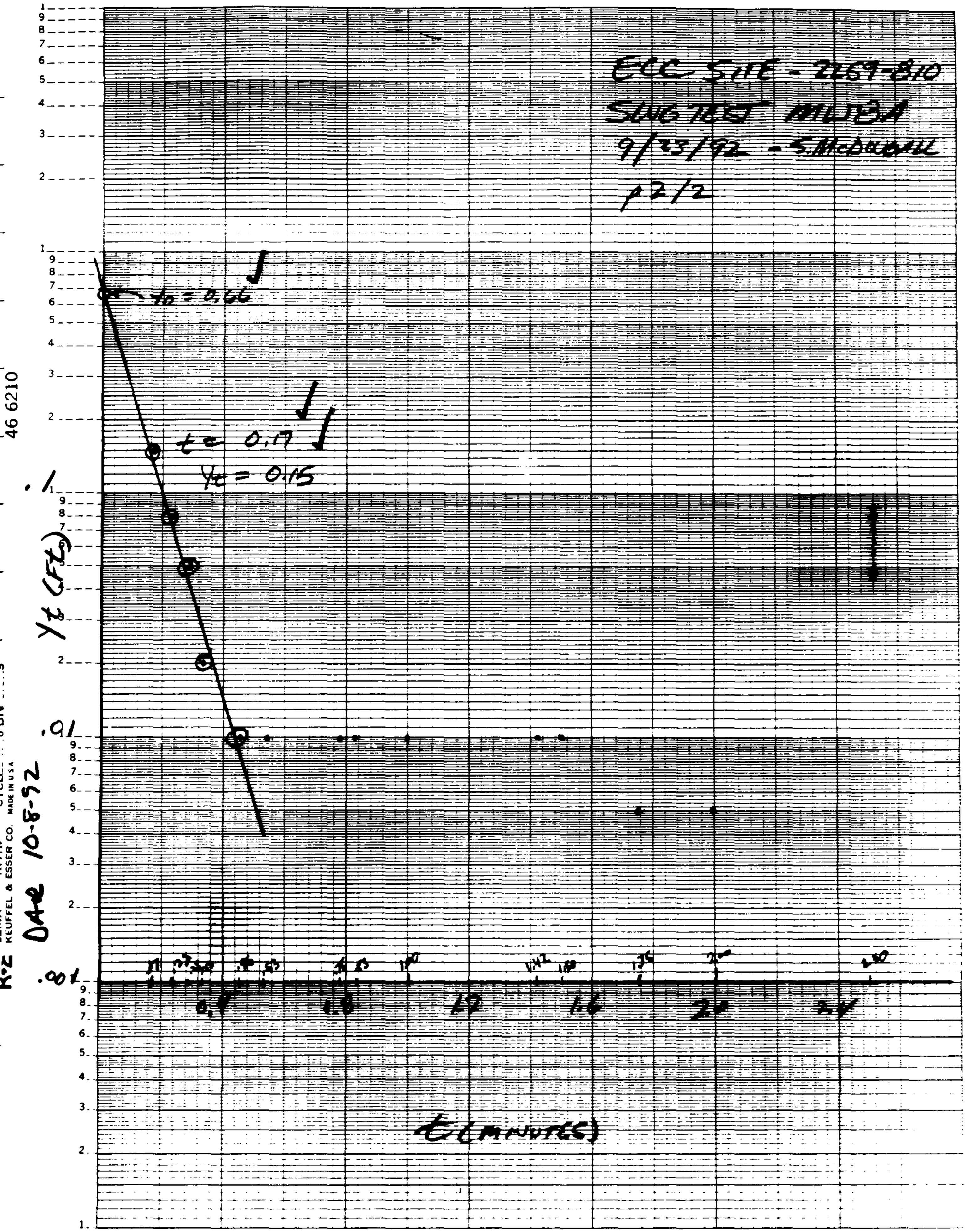
$$K = \frac{r_c^2 \ln R_e/r_w}{2L_e} \frac{1}{t} \ln\left(\frac{y_0}{y_t}\right)$$

$$= \frac{(0.085)^2 \cdot 2.75}{2 \cdot 8} \frac{1}{0.17} \ln\left(\frac{0.66}{0.15}\right)$$

$= 1.1 \times 10^{-2}$ ft/min ✓

$= 5.6 \times 10^{-3}$ cm/sec ✓

AWD021 5/90

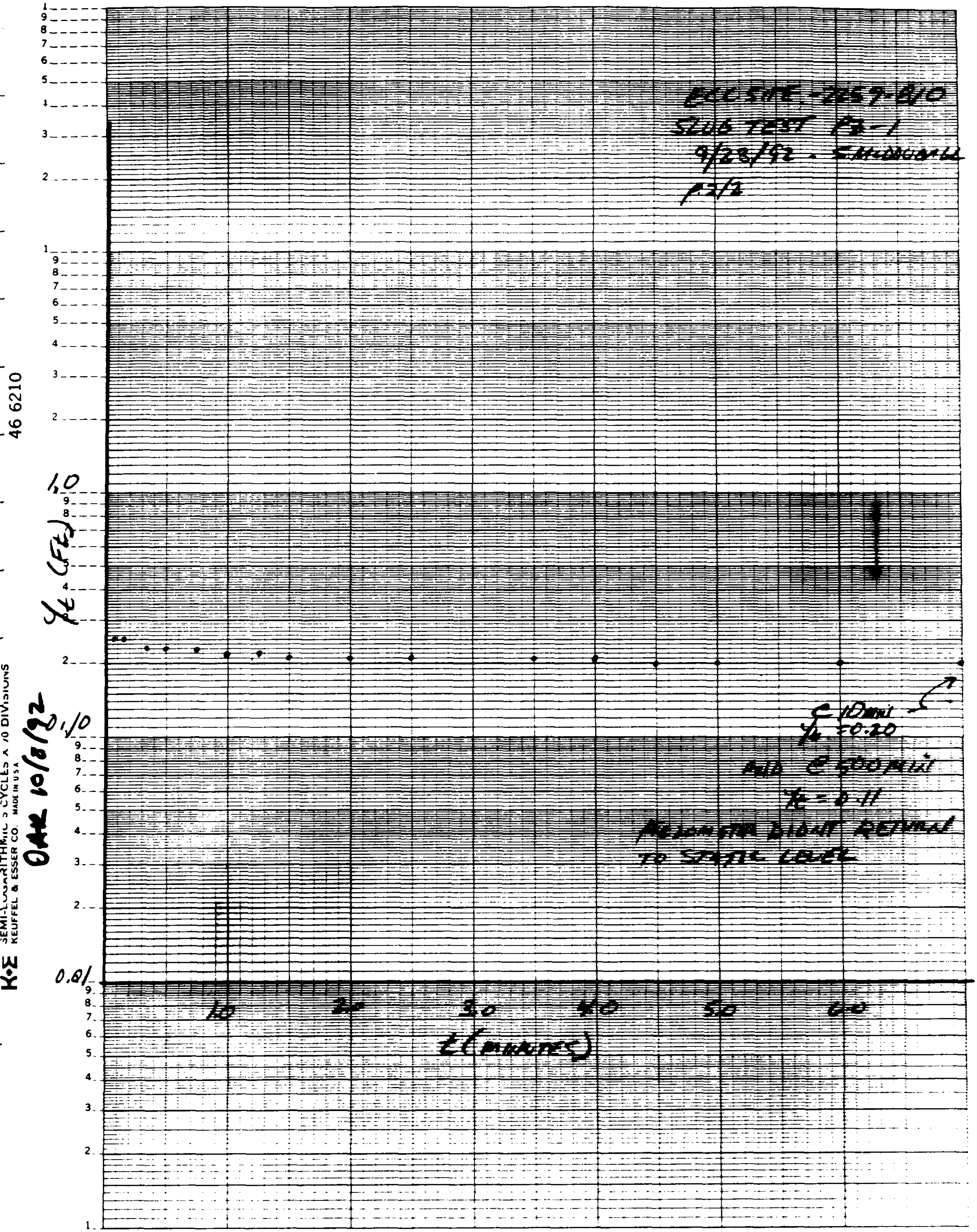

ECC SITE - 2259-810
SLUG TEST MW-3A
9/23/92 - S. McDougall
p 2/2
$Y_0 = 0.66$
$t = 0.17$
$Y_t = 0.15$
Y_t (ft)
1.
.1
.01
.001
0.4
0.8
1.2
1.6
2.0
2.4
t (MINUTES)
DATE 10-8-92
K+E SEMI-LOGARITHMIC 3 CYCLES X 70 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.
46 6210

AWD TECHNOLOGIES

CALCULATION WORKSHEET

CLIENT: ECC Site	FILE NO.: 2259-810	BY: S. McDougall	PAGE 1 OF 2
SUBJECT: PZ-1 SLUG TEST		CHECKED BY: DAR 10/8/92	DATE: 9/23/92

PZ1 slug test showed a very slow response and never returned to static level. This is a very shallow piezometer (only 4.26' bgs) and construction data are not available at this time. Although the data appear to indicate low hydraulic conductivity, the data are not considered representative and no calculation has been performed.


ECC SITE -2259-B/O
SLUG TEST PZ-1
9/23/92 . S.McDOUGALL
P.2/2
1.0
0.10
0.01
y_t (Ft)
10
20
30
40
50
60
t (MINUTES)
@ 10min
y_t = 0.20
AND @ 500 MIN
y_t = 0.11
PIEZOMETER DIDN'T RETURN
TO STATIC LEVEL
DAK 10/8/92
K·E SEMI-LOGARITHMIC 3 CYCLES X 70 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.
46 6210

AWD TECHNOLOGIES

CALCULATION WORKSHEET

CLIENT: ECC SITE	FILE NO.: 2259-810	BY: S. MCDOUGALL	PAGE 1 OF 4
SUBJECT: MW 11A SLUG TEST		CHECKED BY: DAR 10/8/92	DATE: 9/23/92

MW 11 A

WELL YIELD VERY LOW, ONLY RESPONDED ABOUT 1/4 OF A FOOT IN 330 MINUTES WITH STILL ANOTHER 1 1/2 FEET TO RECOVER. NORMAL BOWER AND RICE METHOD NOT USED, ALTHOUGH DATA ARE PLOTTED AS y_t vs t ON PAGE 3/4 FOR ILLUSTRATION. WELL SET IN "SILTY CLAY" PER LOG.

PAGE 4/4 SHOWS SEMI-LOG PROJECTION OF RECOVERY DATA. APPROXIMATE FULL RECOVERY WOULD OCCUR AT 1.1×10^7 MINUTES OR 318 DAYS. 90% RECOVERY WOULD OCCUR AT ABOUT 3×10^6 MINUTES OR 35 DAYS. ROUGH K ESTIMATE CAN BE MADE BY SOLVING FOR K USING THIS t_{90} IN FOLLOWING FORMULA:

$$t_{90} = 1.15 \frac{r_c^2}{K L_e}\left(\ln \frac{R_e}{r_w}\right)$$

$$= 1.15 \frac{r_c^2}{K L_e}\left(\frac{1}{\frac{1.1}{\ln(L_w/r_w)} + \frac{c}{(L_e/r_w)}}\right) ✓$$

$2r_c = 2'' = 0.17'$ and $r_c = 0.17/2 = 0.085'$

$2r_w \approx 8'' = 0.67'$ * and $r_w = 0.67/2 = 0.335'$

$H \approx$ [15' (DEPTH WELL) − 3' (SWL BGL)] = 12' *

ASSUMES UNCONFINED CONDITIONS, THAT THIS IS SATURATED AQUIFER THICKNESS (WHICH REALLY IS NOT THE CASE)

$L_w \approx 12'$ (SAY SAME AS H) *

$L_e = 8'$ (5' SCREEN + GUESS OF 3' SAND PACK (?)) *

L_e/r_w = ~~11.94~~ = 23.88

c = ~~1.95~~ = 2.2

(* ASSUMED DUE TO LACK OF SPECIFIC DATA)

AWD TECHNOLOGIES

CALCULATION WORKSHEET

CLIENT: ECC SITE	FILE NO.: 2259-810	BY: S. McDOUGALL	PAGE 2 OF 4
SUBJECT: MW11A SLUG TEST (CONT.)		CHECKED BY: DAR 10/8/92	DATE: 9/23/92

FIRST, SOLVING FOR $\ln R_e/r_w$:

$$\ln R_e/r_w = \frac{1}{\frac{1.1}{\ln(12/0.335)} + \frac{2.2}{23.88}}$$ ✓

$$= 2.50$$

THEN, SOLVE FOR K WITH $t_{90} = 3 \times 10^6$ MINUTES **
(**ASSUMES PROJECTED CURVE ON P 4/4 FOLLOWS LINEAR PLOT FOLLOWING DATA POINTS FROM t=150 to t=330 MINUTES)

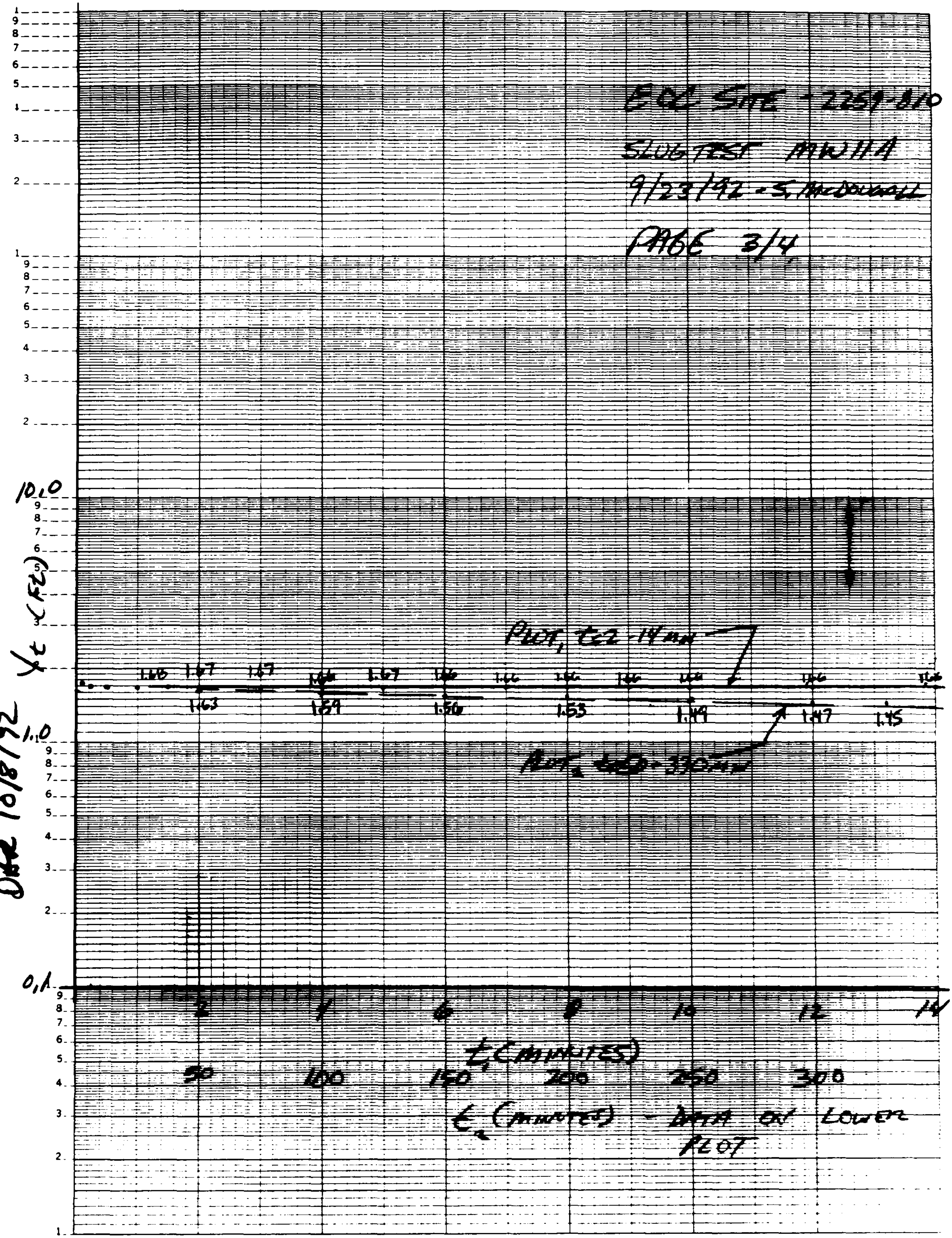
$$3 \times 10^6 = \frac{1.15\,(0.085^2)}{K \cdot 8}\, 2.50$$ ✓

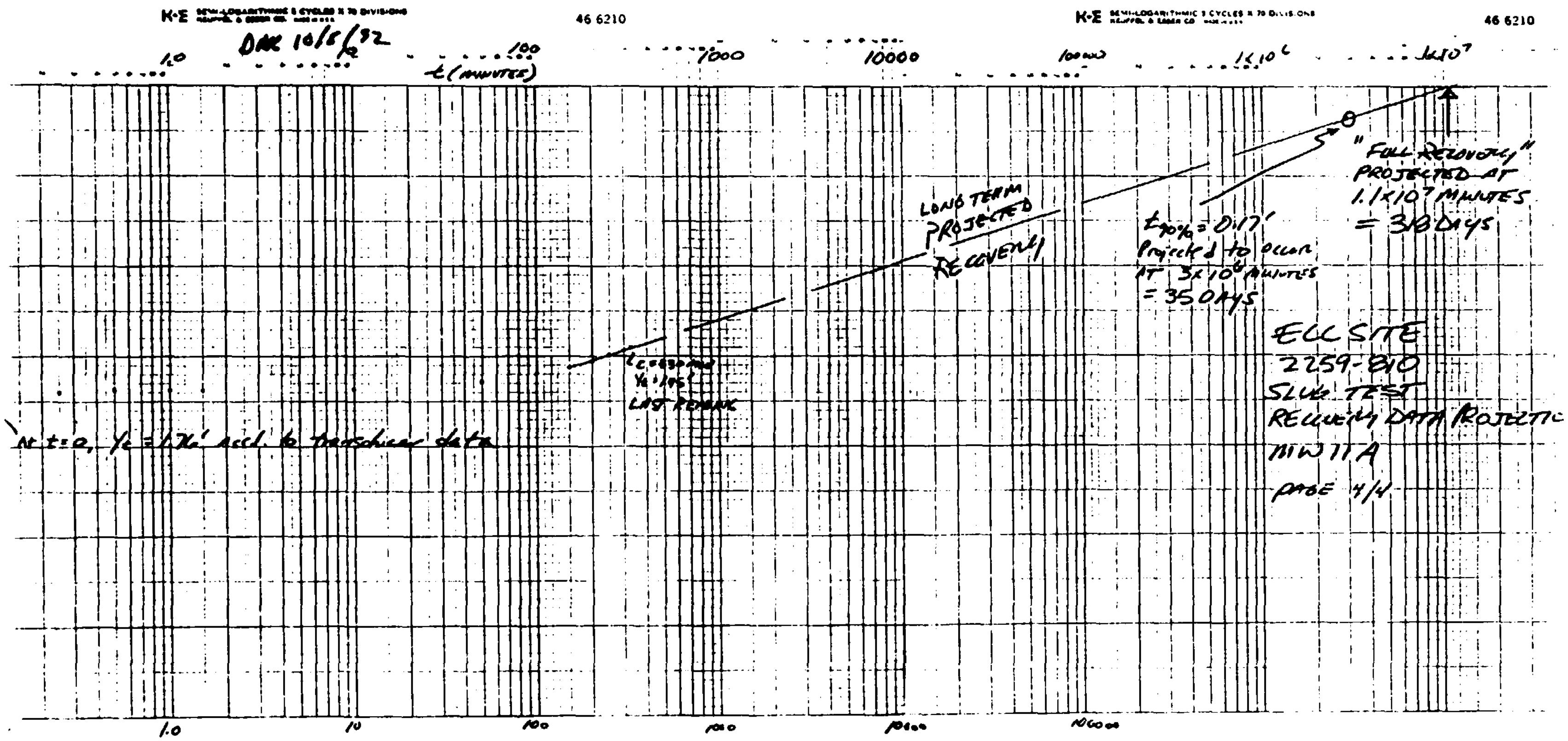
$$K = \frac{1.15\,(0.085^2)}{3 \times 10^6 \cdot 8}\, 2.50$$

$$K = 8.7 \times 10^{-10}\ \text{ft/min}$$

$= \underline{4.4 \times 10^{-10}\ \text{cm/sec}}$ <u>VERY APPROXIMATE</u>

— Value not realistic for known lithology —


EQC SITE - 2259-810
SLUG TEST MW11A
9/23/92 - S. MACDOUGALL
PAGE 3/4
10.0
1.0
0.1
Y_t (ft)
PLOT, t=2-14 MIN
1.68
1.67
1.67
1.66
1.67
1.66
1.66
1.66
1.66
1.66
1.66
1.66
1.63
1.59
1.56
1.53
1.49
1.47
1.45
PLOT₂ t=50-330 MIN
2
4
6
8
10
12
14
t₁ (MINUTES)
50
100
150
200
250
300
t₂ (MINUTES) - DATA ON LOWER PLOT
DKK 10/8/92
K+E
46 6210
SEMI-LOGARITHMIC CYCLES 70 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.


K·E SEMI-LOGARITHMIC 5 CYCLES X 70 DIVISIONS
46 6210
K·E SEMI-LOGARITHMIC 5 CYCLES X 70 DIVISIONS
46 6210
DAK 10/6/92
t (MINUTES)
1.0
100
1000
10000
100000
1×10⁶
1×10⁷
LONG TERM PROJECTED RECOVERY
Projected to occur AT 3×10⁶ MINUTES = 35 DAYS
"FULL RECOVERY" PROJECTED AT 1.1×10⁷ MINUTES
ECC SITE
2259-810
SLUG TEST
RECOVERY DATA PROJECTIC
MW 11A
PAGE 4/4
LAST READING
1.0
10
100
1000
10000
100000

AWD TECHNOLOGIES

CALCULATION WORKSHEET

CLIENT:	FILE NO.: 2259-810	BY: AN	PAGE 1 OF 2
SUBJECT: Permeability Test Well-ECC10A		CHECKED BY: DAR [illegible]	DATE: 9/24/92

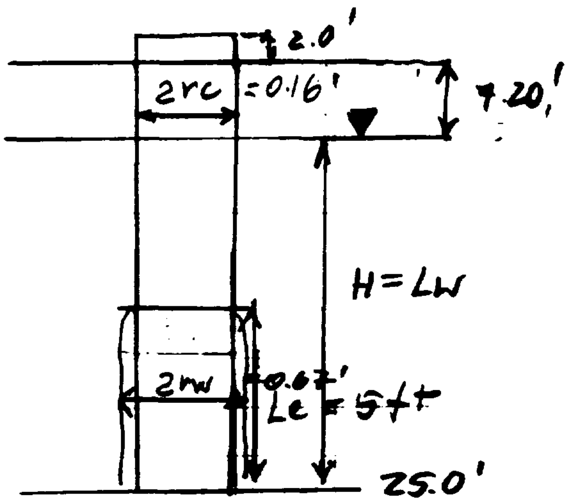
Bouwer and Rice Method

$$K = \frac{r_c^2 \ln(Re/r_w)}{2Le} \frac{1}{t} \ln \frac{y_o}{y_t} \qquad (1)$$

$$\ln \frac{Re}{r_w} = \frac{1}{\frac{1.1}{\ln(L_w/r_w)} + \frac{A + B\ln[(H - L_w)/r_w]}{(Le/r_w)}} \qquad (2)$$

$$\ln \frac{Re}{r_w} = \frac{1}{\frac{1.1}{\ln(L_w/r_w)} + \frac{C}{(Le/r_w)}} \qquad (3)$$

Well ECC-10A



Assumption

$H = L_w = 17.80$ ft
$2r_w = 0.67$ ft $r_w = 0.33$ ft
$Le = 5$ ft

Data

$2r_c = 0.16$ ft $r_c = 0.08$ ft
stickup 2.0 ft
water table 7.20 ft below ground surface

When $H = L_w$ equation 2 cannot be used the equation 3. Will be used for $\ln \frac{Re}{r_w}$

AWD TECHNOLOGIES

CALCULATION WORKSHEET

CLIENT:	FILE NO.: 2259-810	BY: AN	PAGE 2 OF 2
SUBJECT: Permeability Test Well ECC-10A		CHECKED BY: DAR 10/8/92	DATE: 9/24/92

$$\frac{Le}{rw} = \frac{5}{0.33} = 15.15 \qquad c = 2.0$$

$$\ln \frac{Re}{rw} = \frac{1}{\frac{1.1}{\ln \frac{17.80}{0.33}} + \frac{2.0}{15.5}} = 2.5 \checkmark$$

From graph

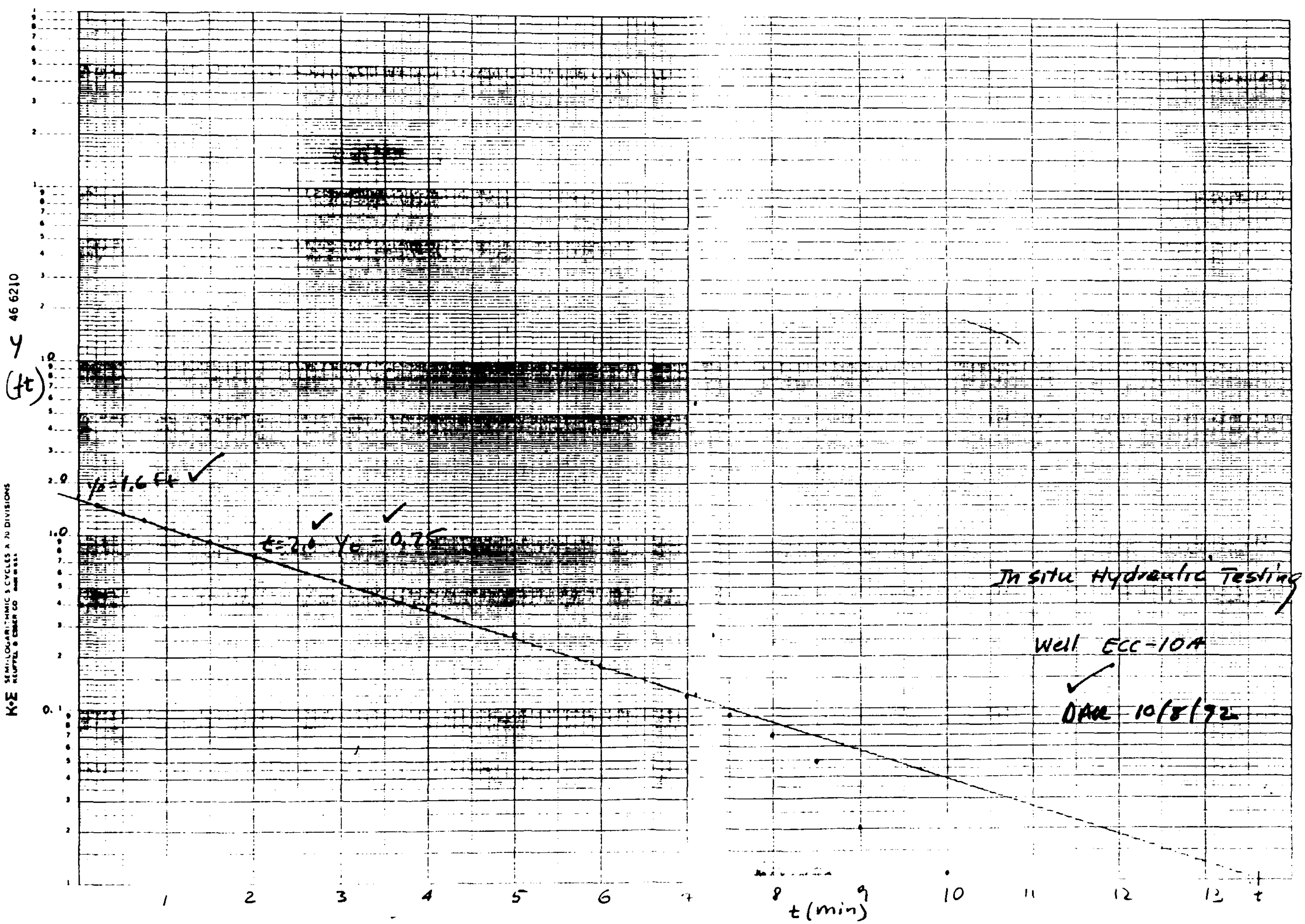
$y_0 = 1.6 ft; \quad t = 2 min \quad y_t = 0.75$

Equation(1)

$$K = \frac{(0.08)^2 \cdot (2.5)}{2 \times 5} \frac{1}{2} \times \ln \frac{1.6}{0.75}$$

$$= 6.1 \times 10^{-4} ft/min =$$

$$= 0.3 ft/day = 3.1 \times 10^{-4} cm/sec$$



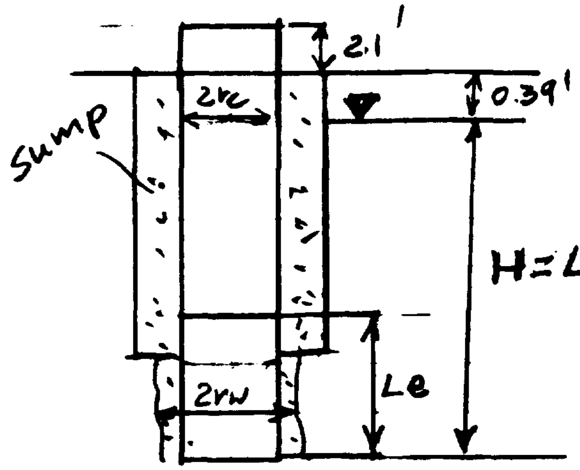
$y_0 = 1.6$ ft
$t = 2.0$ $y_c = 0.75$
In situ Hydraulic Testing
Well ECC-10A
DATE 10/8/92
t (min)
y (ft)
46 6210
K+E SEMI-LOGARITHMIC 3 CYCLES X 70 DIVISIONS
KEUFFEL & ESSER CO.

AWD TECHNOLOGIES

CALCULATION WORKSHEET

CLIENT:	FILE NO.: 2259-810	BY: AN	PAGE 1 OF 2
SUBJECT: Permeability Test Well ECC-MW12		CHECKED BY: DAR 10/8/92	DATE: 9/24/92

Well ECC MW-12



Assumption

$H = L_w = 14.61\ ft$

$2r_w = 0.67\ ft$ $r_w = 0.33\ ft$

Data:

$L_e = 5\ ft$

stick up 2.1 ft

water table 0.39 ft below ground surface

Equation 3 is used because $H = L_w$

$$\frac{L_e}{r_w} = \frac{5}{0.33} = 15.15 \qquad C = 2.0$$

$$\ln\frac{R_e}{r_w} = \frac{1}{\dfrac{1.1}{\ln\dfrac{14.61}{0.33}} + \dfrac{2.0}{15.5}} = 2.38$$

From graph: $y_0 = 1.5\ ft$ $t = 0.2\ min$ $y_t = 0.25\ ft$

Equation (1)

$$K = \frac{(0.08)^2 \times (2.38)}{2 \times 5} \times \frac{1}{0.2} \times \ln\frac{1.5}{0.25} = 1.36 \times 10^{-2}\ ft/min$$

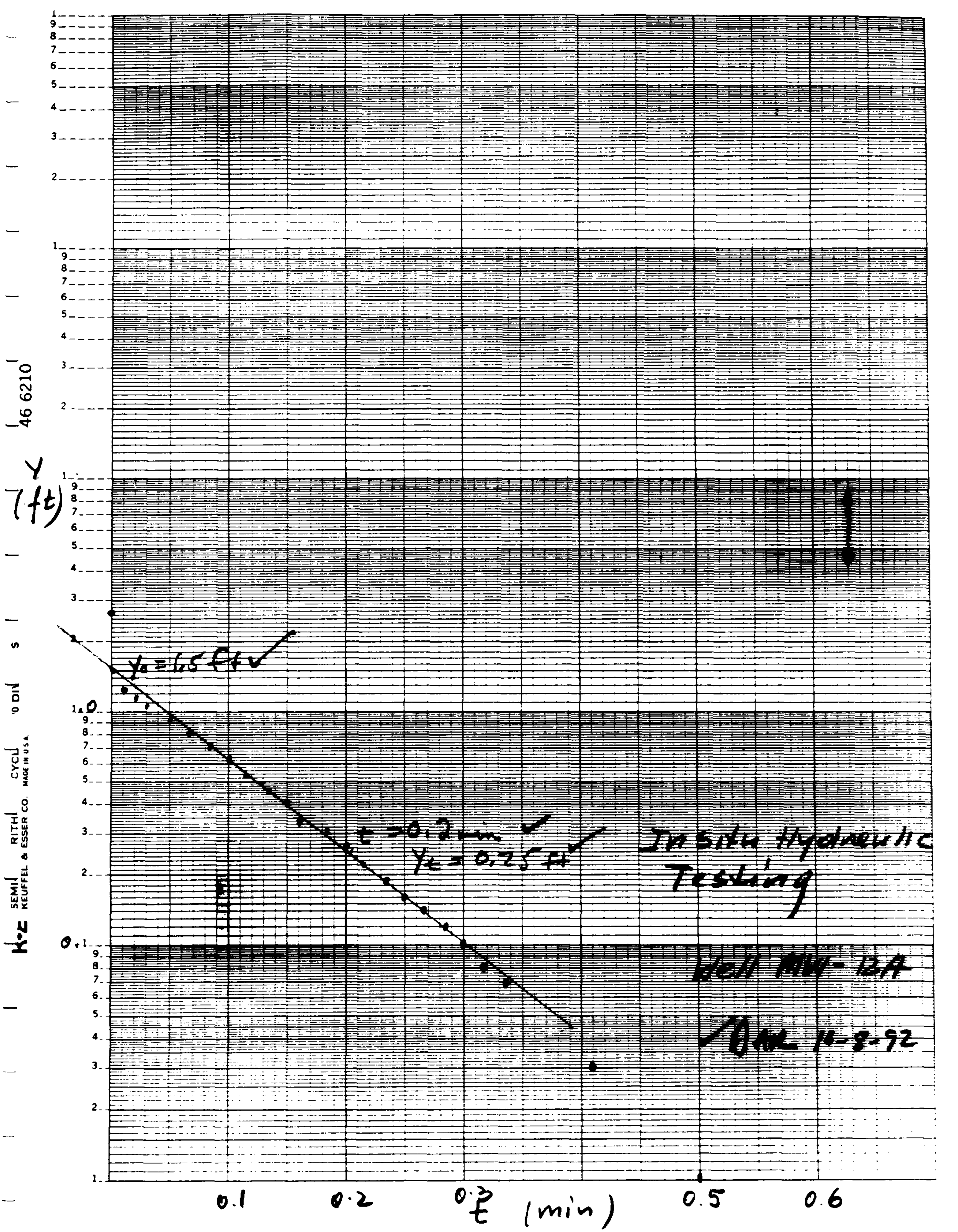
AWD TECHNOLOGIES

CALCULATION WORKSHEET

CLIENT:	FILE NO.: 2259-810	BY: AW	PAGE 2 OF 2
SUBJECT: Permeability Test Well ECC MW-12		CHECKED BY: DAR 10/8/92	DATE: 9/24/92

$K = 1.36 \times 10^{-2}$ ft/min

$K =$ cm/sec $=$ 6.9×10^{-3} cm/sec ✓



Y (ft)
t (min)
0.1
0.2
0.3
0.5
0.6
1.0
0.1
$y_0 = 1.5$ ft
$t = 0.2$ min
$y_t = 0.25$ ft
In situ Hydraulic Testing
Well MW-12A
11-8-92
K·E SEMI LOGARITHMIC 5 CYCLES X 70 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.
46 6210

APPENDIX B

PRELIMINARY DEWATERING CALCULATIONS

AWD TECHNOLOGIES

CALCULATION WORKSHEET

CLIENT: ECC Trust Group	FILE NO.: 2259-810	BY: DAR	PAGE 1 OF 6
SUBJECT: Preliminary Dewatering Calc Rev. 1		CHECKED BY: [signature]	DATE: 10-6-92

I. Volume of Water In Storage

- Entire surface area = 133,006 ft^2
- Depth of saturation - use avg 1.5 ft across site
- Depth of trenches (for storage calc) use 9 ft
- From RI use porosity of 10% across site
- $V_{total} = (SA) \times b_{sat}$

$$= (133,006)(7.5)$$
$$= 997545$$

$$V_{liquid} = (V_{Tot})(n)$$
$$= (997545)(0.10)$$
$$= 99,755\ ft^3$$
$$\boxed{\cong 750,000 \text{ gallons}}$$

![AWD TECHNOLOGIES]

CALCULATION WORKSHEET

CLIENT: ECC Trust Group	FILE NO.: 2259 810	BY: OAR	PAGE 2 OF 6
SUBJECT: Preliminary Dewatering Calc. Rev. 1		CHECKED BY: [signature]	DATE: 10-6-92

II. Preliminary Flow Calculation

- Problem - Calculate a total flow from a dewatering system that would lower the present water table at ECC site down to 9 feet below ground surface with respect to the operation of the SVES.

- Assume that dewatering of the remedial area will take place in approximately half of the planned trenches. Assume 19 trenches from north to south. The length of the trenches will vary according to the width of the remedial area. The depth is controlled by the lithology as depicted in the generalized Cross section in Figure 5. It is assumed that the bottom of the dewatering trenches will be greater than 9 feet to allow dewatering down to 9 feet. In addition, it is assumed that the saturated thickness is between 10 and 12 feet to allow for a minimum of 3 feet between the base of the saturated zone (the till unit) and the top of the sand and gravel unit.

- This assumption does not include hydraulic influence from the underlying sand and gravel unit, and does not include the reduction of local recharge after placement of the cap.

AWD TECHNOLOGIES

CALCULATION WORKSHEET

CLIENT: ECC Trust Group	FILE NO.: 2259-810	BY: DAR	PAGE 3 OF 6
SUBJECT: Preliminary Dewatering Calc. Rev. 1		CHECKED BY:	DATE: 10-6-92

- The formula used is for a single trench under steady-state conditions. It is assumed that this formula will overestimate the total flow (if the hydraulic parameter assumptions are correct) because it does not take additive drawdown into account.

- Trench length assumptions (from north to south)

Trench No.	Length
1-8	265
9-3	125
14-17	165
18	140
19	100

- Formula used:

$$Q = \frac{K(H^2 - h^2)}{2880\ L_o}(x) =$$ flow per unit length from one side of trench in unconfined conditions

Q = Flow rate in gpm

b = "thickness of aquifer" in this case - top of saturated zone to the "base" of the till unit (allowing for approx 3 feet of till between the "base" and the top of the sand and gravel) in feet

H = Saturated thickness

h = depth of water in trench while pumping [Note that trench bottom will be constructed below 9ft] in feet

AWD TECHNOLOGIES

CALCULATION WORKSHEET

CLIENT: ECC Trust Group	FILE NO.: 2259-810	BY: DAR	PAGE 4 OF 6
SUBJECT: Preliminary Dewatering Calc. Rev. 1		CHECKED BY: JM	DATE: 10-6-92

• Formula used (cont'd)

L_o = distance from center point of dewatering trench to center point of adjacent injection trench in feet

X = Unit length of trench in feet

K = Assumed hydraulic conductivity of 1.0×10^{-5} cm/sec in gpd = $\underline{0.21 \text{ gpd/ft}^2}$

a) Trenches 1-8

$$Q = \frac{(0.21 \text{ gpd/ft}^2)[(12.0^2)-(9.0^2)]}{(2880)(20)}(265)$$

$Q = 6.0 \times 10^{-2}$ gpm per one side of one trench

$Q_{total} = (2 \text{ sides})(8 \text{ trenches})(6.0 \times 10^{-2})$

$$\boxed{Q_{Total\ 1\text{-}8} = 0.96 \text{ gpm}}$$

b) Flow to trenches 9-13

$K = 0.21$ gpd/ft²
$b = 12$ ft
$H = 12$ ft
$h = 9$ ft

$L_o = 20$ ft.
$X = 125$ ft.

$$Q = \frac{(0.21)[(12^2)-(9)^2](125)}{(2880)(20)} = 3.7 \times 10^{-2} \text{ gpm}$$

$Q_{Total} = (2 \text{ sides})(5 \text{ trenches})(3.7 \times 10^{-2})$

$$\boxed{Q_{Total\ 9\text{-}13} = 0.30 \text{ gpm}}$$

AWD TECHNOLOGIES

CALCULATION WORKSHEET

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c) Flow to trenches 14-17

$K = 0.21$ $\quad L_o = 20$ ft.

$b = 10$ ft $\quad X = 165$ ft.

$H = 10$ ft

$h = 9$ ft.

$$Q = \frac{(0.21)[(10^2) - (9)^2](165)}{(2880)(20)} = 0.01 \text{ gpm}$$

$$Q_{Total\ 14\text{-}17} = \underline{(2 \text{ sides})(4 \text{ trenches})(0.01)}$$

$$\boxed{Q_{Total\ 14\text{-}17} = 0.08 \text{ gpm}}$$

d) Flow to trench #18

$K = 0.21$ $\quad L_o = 20$ ft.

$b = 10$ ft. $\quad X = 140$ ft.

$H = 10$ ft.

$h = 9$ ft.

$$Q = \frac{(0.21)[(10^2) - (9)^2](140)}{(2880)(20)}$$

$$Q = 9.7 \times 10^{-3}$$

$$Q_{Total} = (2 \text{ sides})(1 \text{ trench})(9.7 \times 10^{-3})$$

$$\boxed{Q_{Total} \cong 0.01}$$

AWD TECHNOLOGIES

CALCULATION WORKSHEET

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e) Flow to trench #19

$K = 0.21$ $\qquad L_o = 20$ ft.

$b = 10$ ft. $\qquad X = 100$ ft.

$H = 10$ ft.

$h = 9$ ft.

$$Q = \frac{(0.21)\left[(10^2)-(9^2)\right](100)}{(2880)(20)} \times 2\text{ sides} \times 1\text{ trench} \boxed{\cong 0.01}$$

$$Q_{Total\ 19} = 0.96 + 0.30 + 0.08 + 0.01 + 0.01$$

$$\boxed{Q_{\text{Total steady state, Trenches \#1-19}} = 1.43 \text{ gpm}}$$

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DRAFT

IND-92-BKG-938

October 16, 1992

Ms. Karen A. Vendl
Senior Remedial Project Manager
Office of Superfund
United States Environmental Protection Agency - Region V
77 West Jackson Boulevard
Chicago, Illinois 60604-3590

Subject: Phase I Supplemental Investigation Summary Report
Enviro-Chem Site Final Design
Zionsville, Indiana
AWD Project Number 2259.810

Dear Ms. Vendl:

Enclosed please find two copies of the above referenced summary report. As briefly discussed in the technical memorandum delivered to you on September 29, 1992, and during our meeting on September 30, 1992, the results of the Phase I Supplemental Investigation indicate that the water table is within a few feet of ground surface at the site. Consequently, we have determined that additional investigative work is necessary to better estimate the dewatering requirements or other procedures with respect to operation of the proposed soil vapor extraction system. This additional work, known as the Phase II Supplemental Investigation, was described during our September 30, 1992 meeting, and will be detailed in a work plan to be delivered to U.S. EPA on October 28, 1992.

The results of the Phase I Supplemental Investigation were compiled and evaluated using existing/available survey data. As you know, there were several apparent conflicts regarding well and ground surface elevations. The reported elevations in the report are those from Technical Memorandum No. 2 (CH2M Hill, 1988) except where noted. We have contacted Dr. Frank Mahuta at CH2M Hill in an effort to resolve these conflicts for the Phase II work. Fortunately, the identified conflicts do not appear to have any critical effects on the data interpretation.

AWD Technologies, Inc.
Penn Center West Building III Suite 300 Pittsburgh Pennsylvania 15276 Telephone 412 788 2717 Fax 412 788 1316

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Ms. Karen A. Vendl
United States Environmental Protection Agency - Region V
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If you have any questions or concerns regarding the Phase I report, please contact me.

Sincerely,

For:

Bradford K. Grow
Director of Operations - Indianapolis

BKG/drp

cc: R. Ball - ERM North Central
N. Bernstein - Arent Fox Kintner Plotkin and Kahn
T. Harker - The Harker Firm
J. Kyle - Barnes and Thornburg